Alternative Energy

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IIUM Press

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011

Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

A.K.M. Mohiuddin and Asif Hoda
Alternative Energy
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Include index
Bibliography: p.

ISBN 978-967-418-158-1

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
IIUM PRINTING SDN. BHD.
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan

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Chapter 3

A solar assisted desalination system using heat pump

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ABSTRACT

This paper includes results of an investigation carried out on a desalination plant which consists of a direct expansion solar assisted heat pump (DXSAHP) coupled to a single-effect evaporator unit. The working fluid used in the heat pump is R134a. The distillate is obtained via falling film evaporation and flashing in the evaporator. Experiments have been conducted under both day and night meteorological conditions in Singapore and the effects of solar irradiation and compressor speed on the performance of the system have been investigated. From the experiments, the performance ratio was found to vary between 0.43 and 0.88, the average coefficient of performance was 8 and the highest distillate production recorded was 1.38kg/hr.

Keywords: Solar desalination, single-effect; heat pump; non-conventional collectors.

INTRODUCTION

Desalination systems enable the conversion of seawater into portable water and alleviate water shortages in many parts of the world, especially in the Middle East. As global population increases, while more water sources get polluted, desalination will play an increasingly important role. There are three basic methods of desalination: multi-stage flashing (MSF) and multi-effect distillation (MED); reverse osmosis (RO); and electro-dialysis (ED). Most desalination methods are energy-intensive processes and, hence, the cost of water production dependents on the prices of fossil fuels. Kalogirou [1] and Miller [2] pointed out that reducing energy consumption can have a major impact on overall water costs. Tzen and Morris [3] proposed the use of renewable energy sources (RES) coupled with existing technologies as one method, whereby, reliance on fossil fuels can be reduced; desalination costs can be lowered in the long run and does not result in environmental degradation. Rodriguez and Camacho [4] considered the use of solar energy as one of the most promising applications of renewable energy for desalination.

The heat pump is a useful device in transforming low-grade heat from the air, ground and solar radiation into a usable source. Experiments were performed on the use of heat pumps for desalination